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ABSTRACT

The science of physics teaches the world to look beyond what is known and to be creative about visions of the future. Educators, like scientists, are responsible for pointing forward, for looking around and beyond the realm of what is known, to the realm of what could be. Yet, most institutions are restrained by traditional frameworks. Education still applies strategies designed for an industrial society which no longer exists. Since institutions are slow to adapt to the demands of the current age, teachers must bring new approaches into their classrooms. Initially, physicists were intrigued by both the spiritual and physical nature of man and his world. Early Greek educators also considered both the psychological and physical needs of the student. However, the industrial age defined educational goals in terms of acquiring individual competencies. This dismemberment of the whole educational process is akin to isolating the atom; in so doing, the true state of the atom is altered. A learning process which isolates educational elements is inadequate. In order to adapt educational systems to the present world, a new approach must be developed, much as quantum mechanical theories were required to help explain the mysteries of the subatomic world. The movement toward cooperative learning, holistic educational approaches, and cross-disciplinary strategies are good indicators that education is awakening to the interconnectedness of people and knowledge. As instructors trust students to learn from each other, the classroom becomes a domain of creativity in which the different parts enlighten each other. (JMC)

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Physics and the Art of Teaching

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PHYSICS AND THE ART OF TEACHING

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INTRODUCTION

This paper is designed to create questions, not answers. I am not a physicist, except in the broad original sense of the word - one who seeks to find the essence of things. As such, I am more committed to raising issues than settling into comfortable solutions to problems.

The science of physics is teaching us lessons which could have a deep impact on the way we perceive ourselves, each other, and everything around us. Above all, it is teaching us to look beyond what we know and to be creative about our vision of the future. Albert Einstein said,

> "The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old questions from a new angle, requires creative imagination and mark real advances in science." (The Evolution of Physics, 1938)

I propose that educators, like scientists, are responsible for pointing forward, for looking around and beyond the realm of what is known, to the realm of what could be.

Yet, I despair at our apparent addiction to what has already been done. In most of our institutions, even among the best and most creative, we are restrained by institutional frameworks which demand that we don the cloak of the past. We arm ourselves with research which is already old by the time it is published. We process our ideas through pilots programs and committees, and endure the unprocessed criticism of colleagues who are often less informed than ourselves on particular issues. If our ideas survive, we are then allowed to enter the approval process and the red-tape that it involves. It is no wonder that many of us withdraw into the cocoons of our conventional classrooms, only to be seen and heard again by the institution when a survival issue demands immediate participation. This is happening in an era during which revolutionary changes are occurring in our student populations and in our knowledge about the world and how it works.

Alvin Toffler (1980) sees our age as a Communications Age, where information is transmitted at lightning speed, no longer bound by conventional transportation and time restraints. Indeed, we have shattered our shells, but we are afraid to leave

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them behind. We carry the remnants of the "little red school house" on our backs and tiptoe into the space age when we could be soaring.

Yet, I do not perceive teachers as victims. We are not products of our institutions. We are not bound by the mechanics of our "trade." Most of us are still allowed our individuality in the classroom, and it is there that the magic occurs.

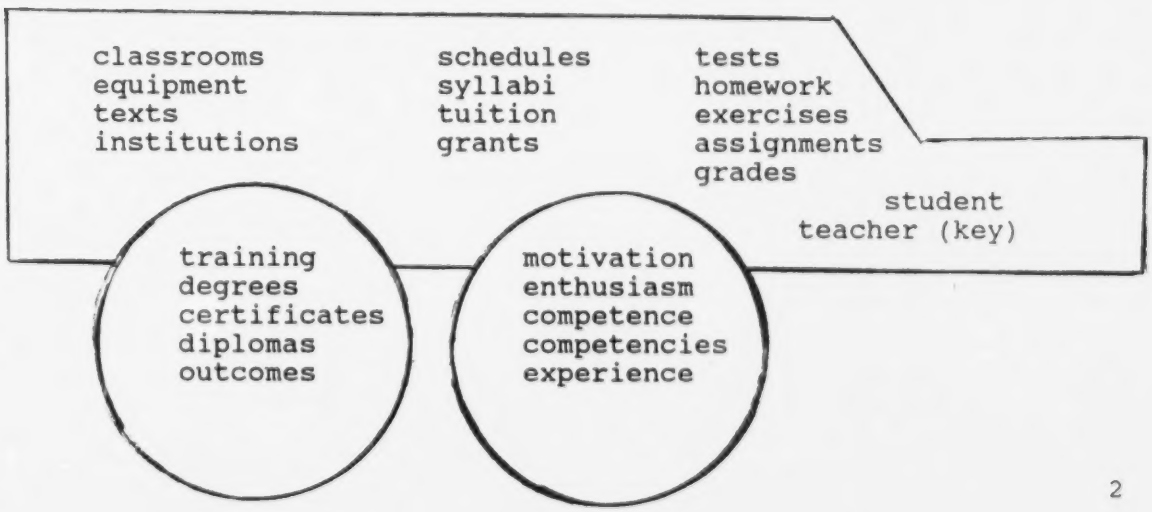
If we could only see our teaching as an art, that is, as a creative experience, we could allow ourselves to experience the artist's "high." I believe that if we could only trust what quantum physicists are telling us - that we are not isolated particles but live energies creating the nature of every moment through our contact with each other -that we could appreciate creation in every session within the walls of our superficial classrooms.

PROPOSAL

I propose that, whereas we have little control over the scheduling, seating, curriculum, texts, and other traditional aspects of our experience, we can, nevertheless, use those static elements as our canvas to create a blend of dynamic forces which in their interaction will produce a work of art. I am not suggesting a work of art to be framed, but to be experienced; where humans interact with each other to experience and participate in the other's knowledge; where the total of all so-called parts becomes greater than their sum. Is that possible?

EDUCATION

Education, whatever its level, has been approached by those who determine its mission, as though it were a mechanical model. The model has static parts which people believe can be assembled and sparked:



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We who are educators are often fascinated by the mechanics of our profession. We want formulas that will work. We research, categorize, eliminate the subjective "I" from our reports, and draw conclusions from the latest information available. Never before has so much information been available! Yet, we appear to still grope in the dark.

> "More American citizens have devoted more energy than has probably been expended in all other countries combined to try to shape a coordinated adult education movement in this country. These efforts have resulted in a succession of local, state, regional, and national adult education councils and associations that have met with only small successes and large frustration in their attempts to create a unified field of adult education." (A History of the Adult Education Movement, Preface)

Why are we so feeble?

I suggest that our inadequacy results from applying strategies designed to cope with the outcomes of our industrial revolution when we are no longer an industrial society! We want our mechanical models to run in a non-mechanical environment. I am not suggesting that mechanical laws of physics do not apply in specific instances. I am amused, for instance, at the concept of "work" as defined in physics. In order for "work" to occur, physicists say that movement or change must also occur. I buy that! Yet, how often do we as teachers hear students and colleagues claim that they work so hard and yet nothing happens. That would seem to be a contradiction in terms. Perhaps we should describe much of this kind of effort as "force" rather than work. Students could say, "I forced on this lesson, but learned nothing." Our colleagues could say, "I forced all year and I think they should pay me more." The term "meaningful work" would take on a much more precise meaning.

At any rate, it seems obvious that the strategies we have used to educate our people are not keeping pace with the demands of our time. Or it may be that we have had significant success and that our evaluation measures are too archaic to recognize it.

Joe Dominguez, in his seminar "Changing Your Relationship With Money" (and with life...), tells about the proverbial rat, who tries to find the cheese by examining all other paths until he finds path number four, where the cheese lies. Once he finds the cheese he goes to number four with increasing speed, and eventually goes directly to number four for his reward. If the cheese is then moved to path number two, the

rat will go to path four only long enough to determine that the cheese must now be somewhere else. He then proceeds to look into other paths until he finds the new location. The difference, says Dominguez, between rats and humans is that humans keep going back to number four instead of looking elsewhere. They are more interested in being right than in finding the "cheese."

I do not want to suggest that we do not have the intelligence of a rat, but the story makes a point. We should be anxious to change our approaches. Instead, I find that we are slow to change - too slow for the demands of our time. And when we do change, we settle into new modes so well that we are slow to move again.

Robert Trask, President of the Private Industry Council in Corpus Christi, Texas, and luncheon speaker for a conference held by the Texas Higher Education Coordinating Board in 1989, proposed that we should emulate cockroaches instead of dinosaurs (I have not noticed too many cockroach T-shirts lately...). He claimed that the dinosaurs are extinct because they did not have the ability to change with the times. Yet, the cockroach, ready to adapt to any new environmental change, thrives in our cupboards and baseboards. He pointed out that our educational institutions are still producing graduates which industry has to train, even in basic skills. If institutions do not adapt their strategies to the rapidly changing demands of our times, they will inevitably become extinct. Are educational institutions becoming a thing of the past?

I have not lost hope for our institutions. I am not even cynical about the mission they propose to fulfill or the methods they choose (although I seriously wonder about local politicians establishing educational policy...). But I recognize that most institutions cannot, or will not, adapt from the top. To a great extent, they become what we as teachers are doing in the classroom. Most institutions are responsive, at best, and if teachers are being creative and informed about the needs of the students they serve, institutions will change. The contact between student and teacher is still what defines the quality of learning, and it is time that we teachers recognize how intimately involved we are with our students in this whole process of discovering the universe.

PHYSICS AND EDUCATION: A COMPARISON

I have been fascinated by Fritjof Capra's account of the discoveries brought about by quantum physics in The Tao of Physics. Although his perspective leads to parallels between what physicists are discovering and what mystics have long believed, I will leave mysticism aside and deal with how I perceive the basic lessons of quantum physics relating to encouraging art in teaching. The quotes which follow were taken

from The Tao of Physics and are used as the foundation for this paper.

> "The term "physics" is derived from this Greek word [physis] and meant therefore, originally, the endeavor of seeing the essential nature of things." (p. 6)

Initially, then, physicists were intrigued by both the spiritual and physical nature of man and his world. Early Greek educators also considered both the mental and physical aspect of the student. Later,

> "The Greek atomists drew a clear line between spirit and matter, picturing matter as being made of several "basic building blocks." These were purely passive and intrinsically dead particles moving in the void." (p. 7)

Is this thought not akin to our interest in competencies as building blocks to accomplishments in particular disciplines?

> "The birth of modern science was preceded and accompanied by a development of philosophical thought which led to an extreme formulation of the spirit/matter dualism. This formulation appeared in the Seventeenth Century in the philosophy of Rene Descartes, who based his view of nature on a fundamental division into two separate and independent realms: that of mind (res cogitans), and that of matter (res extensa). The 'Cartesian' division allowed scientists to treat matter as dead and completely separate from themselves, and to see the material world as a multitude of different objects assembled into a huge machine. Such a mechanistic world view was held by Isaac Newton, who constructed his mechanics on its basis and made it the foundation of classical physics. From the second half of the seventeenth to the end of the nineteenth century, the mechanistic Newtonian model of the universe dominated all scientific thought." (p. 8-9)

This model continues to dominate much of our approach to education. We are fascinated by the idea of defining our educational goals to their smallest competency. Competency based education is an attempt to isolate subject matter into small enough units so that students then can be led through the "hoops", tested, and guaranteed proficiency in the subject on the

other end. The process is appealing to our industrial minds. We want to assemble quality parts, in a pre-determined sequence, and control the production of a quality product. When we were criticized in the fifties for the inadequacy of our educational system in the United States, we jumped to implement strategies we knew had been successful in our economy.

PARTS OR ASPECTS?

Our view of the universe used to be that it was composed of separate particles, called atoms, which could be isolated, studied and thus provide infinite wisdom about our own nature. An atom to the classical physicist was a separate particle.

> "The belief that all these fragments--in ourselves, in our environment, and in our society--are really separate can be seen as the essential reason for the present series of social, ecological, and cultural [and educational] crises. It has alienated us from nature and from our fellow human beings. It has brought a grossly unjust distribution of natural resources, creating economic and political disorder; an ever-rising wave of violence, both spontaneous and institutionalized, and an ugly, polluted environment in which life has often become physically and mentally unhealthy." (p. 9)

In Education, this view has led to confusion about why certain things work or do not work. We keep putting money into the jar only to get ashes in return. We live in an illiterate society as a result of this perception. We know we have failed and yet continue to go down the same path only to find the cheese is no longer there. When results are good, we rush to replicate the formula, never questioning the real reasons behind the success: the funding, the people involved, the goals of the people involved, the interaction between certain types of people in the program, the climate, the nature of the institution, the nature of the community, and so forth. Even if we could get answers to these questions, and I do not believe we can, to replicate a model is impossible.

> "The philosophical basis of this rigorous determinism was the fundamental division between the I and the world introduced by Descartes. As a consequence of this division, it was believed that the world could be described objectively, i.e., without ever mentioning the human observer, and such an objective description of nature became the ideal of all science [and of educational research]." (p. 45)

> "As a consequence of the Cartesian division, most individuals are aware of themselves as isolated egos existing 'inside' their bodies. The mind has been separated from the body and given the futile task of controlling it, thus causing an apparent conflict between the conscious will and the involuntary instincts. (p. 9)

In a broader sense, we see ourselves as isolated teachers moving about in classrooms which we are responsible for nurturing, motivating, controlling and eventually moving into another level of knowledge. Even in the most flexible and encouraging institutions, education is prescriptive. We are bound by the walls of research (never use "I"!) and the latest information about what "works" in our fields.

In institutions of higher learning, fragmentation is as prevalent as in other areas. We are not only separated by the walls of our classrooms, but by the walls of our respective disciplines and institutional roles, and their particular characteristics.

Elsner and Ames (1983) look at this fragmentation as negatively affecting the effectiveness of college support services.

> "What kinds of student services do community colleges offer today? Based on a study of 123 junior colleges supported by Carnegie Corporation, the American Association of Junior Colleges (1965, p. 15) offered a definition of community college student services as 'a series of related functions to support institutional programs, respond to student needs and foster institutional development.' This study demonstrated that student service functions were 'woefully inadequate' and that the traditional functions of admissions, orientation, and counseling were neither uniformly integrated nor adequately supported." (Issues for Community College Leaders p. 140)

> "Perhaps this is one of the generic difficulties with the student services movement: It has too many sources of entry and too many similar, yet distinctly different, types of preparations for practitioners." (p. 141)

Just as physics originally embodied both aspects of the universe (spirit & matter), adult education was also general at

first and later became specialized. In fact, the whole general education movement is propelled by the desire to revert to that approach.

> "The general character of educational content shifted from general knowledge to several pin-pointed ares of emphasis -vocational education, citizenship and americanization, the education of women, civic and social reform, public affairs, leisure-time activity, and health. Adult education was clearly in tune with the needs of this era of industrialization, immigration, emancipation, urbanization, and natural maturation." (p.75)

That approach dictated: let's keep isolating particles until we get to the smallest possibility; then we can establish basic competencies and run people through the trough and assure success (a + b = c).

Fragmentation results not only from industrial era strategies; it is also a danger resulting from our increasing ability to communicate effectively in this new age. People can now be served directly without having to congregate in a lecture mode. So there are two significant forces at work, both supporting the possibility of fragmentation, it would seem. The former, however, fragments and isolates; the latter individualizes but offers the significant advantage of networking. Perhaps we will utilize the advantages offered by our new age technology, using it to network rather than isolate, to invite participation rather than passive learning.

MORE FROM PHYSICS

One of the most surprising discoveries in quantum physics is that the atom cannot be isolated as scientists had originally thought. Atoms are not just particles, but waves as well (. and ~), and as such, they cannot be trapped, isolated, and studied without affecting the very nature of the atom during the experiment. In other words, to study an atom, we must inevitably influence its behavior under observation. The observer is an integral part of the experiment, something which is the very opposite of the scientific prescription of providing objective data. There is no such thing. Since all matter is composed of atoms, it would follow that educational models cannot be isolated and replicated since the people involved and the products they produce in any experiment are affected by the interaction of atoms or energies taking place during the implementation of the model.

> "An elementary particle is not an independently existing unanalyzable entity.

It is, in essence, a set of relationships that reach outward to other things."(p. 125)

Atoms exist in relation to each other. People also exist always in relation to their interaction with each other and their environment.

> "The concept of matter in subatomic physics is totally different from the traditional idea of a material substance in classical physics. The same is true for concepts like space, time, or cause and effect. These concepts, however, are fundamental to our outlook on the world around us and with their radical transformation our whole world-view has begun to change." (p. 3)

> "The notion that all scientific models and theories are approximate and that their verbal interpretations always suffer from the inaccuracy of our language was already commonly accepted by scientists at the beginning of this century, when a new and completely unexpected development took place. The study of the world of atoms forced physicists to realize that our common language is not only inaccurate, but totally inadequate to describe the atomic and subatomic reality. Quantum theory and relativity theory, the two bases of modern physics, have made it clear that this reality transcends classical logic and that we cannot talk about it in ordinary language." (p. 32)

> "Einstein experienced shock when he first came in contact with the new reality of atomic physics. He wrote in his autobiography:
>
> > 'All my attempts to adapt the theoretical foundation of physics to this [new type of] knowledge failed completely. It was as if the ground had been pulled out from under one, with no firm foundation to be seen anywhere, upon which one could have built.'" (p. 41-42)

I would like to see the ground pulled out from under our feet as well. I would like for us to regard our teaching

experience as a dynamic interchange of energies occurring within the experimental confines of our classrooms. To me, that is an artistic expression. It is losing oneself and one's identity as student and teacher and becoming something in the moment.

> "The basic oneness of the universe is not only the central characteristic of the mystical experience, but is also one of the most important revelations of modern physics." (p. 117)

> "...The constituents of matter and the basic phenomena involving them are all interconnected, interrelated and interdependent; they cannot be understood as isolated entities, but only as integrated parts of the whole." (p. 118)

HOPE FOR THE "PRESENT"

The idea of synchronicity, the unspoken relationships between supposed parts of the universe, has not been restricted to physics or mysticism. Carl Jung wrote extensively about it. More recently, Edward Hall (1981) discussed his observation of how synchronicity affects cultural behavior. The International Commission on the Development of Education, composed of " the former Prime Minister and Minister of Education of France, the former President of the International Development Bank, a Professor of Nuclear Physics at the University of Damascus, the Minister of Foreign Affairs and the former Minister of Higher Education and Sciences of Iran, and the Advisor on International Education of the Ford Foundation", predicted our present trend toward synchronized educational patterns:

> "The concept of education limited in time (to 'school age') and confined in space (to 'school building') must be superseded. School education must be regarded not as the end but as the fundamental component of total educational activity, which includes both institutionalized and out-of-school education." (p. 348)

If synchronicity among elements of the universe is the reality that now even science is proposing, then we are bound to move into the acceptance of its implications. What I am suggesting here is that we trust the lessons we are learning about our connectedness, and do not struggle to justify our effectiveness through old standards. I want us to avoid putting a leash around our success and dragging it back into our "little red dog houses". If we are learning anything significant, it may

be that we can be free to let nature take its path and enjoy the fruits of its knowledge.

I think the whole movement toward cooperative learning, holistic approaches, and cross-disciplinary strategies, like English and math across the curriculum and content-area language instruction, are good indications that we are awakening to this fact. We are beginning to regard the student as a whole rather than as a learning fragment within our institutions.

We are beginning to see the need for integrating college and community services so that the student can benefit from more than just classroom instruction. But the "little red schoolhouse" also had integrated services. Are we simply adding another view to a static model? Can we go beyond strategy? Could it be that a creative classroom would automatically serve the whole student without creating a new model to integrate those services into the curriculum? When students interact, no secret is well-kept.

The Texas Higher Education Coordinating Board (1989) promotes cooperative learning, which assumes that teachers can step down from the podium and allow students to learn from each other. I am a convert to cooperative learning although I would not restrict it to that label. Learning implies: you know this much, and now you know this much more, and thus you have increased your knowledge by this percentage. Therefore, the teacher is this much successful, or the student has achieved this percentage of what he needs to be successful.

A broader definition might incorporate another very important concept - that since we are part of each other, we are co-creators of our experience, and that we also participate in universal knowledge. In other words, no one "learns" anything. At best, we are enlightening parts of ourselves which were previously unseen for lack of a friendly guide or courage to explore. We might define what happens in an artistic classroom as creative exploration. The artist must trust himself before he expresses. We must trust ourselves and thus, our students, to recognize our mutual existence and allow the creative flow to guide us into new experiences.

The more I allow myself to trust students to learn from each other, the more of a participant I become. I find myself leaving the classroom refreshed, as though I had just written a new song, composed a beautiful poem, or painted a charming landscape. Students feel the same way, they claim. They have taken nothing from me. We have experienced together.

If we are indeed connected in this universe, it is time that we benefit from that knowledge. Instead of looking for ways to motivate, help, and teach, we can assume that we influence each

other whether we plan it or not. We can best channel our energies as teachers so that our students can clearly see their connection and their importance to the rest of the universe.

Canvas, art and artist become one at the time of creation. The classroom, the ideas and the participants in teaching can discover life together. Can't they?

REFERENCES

Capra, Fritjof. The Tao of Physics, New York: Bantam Books, 1988.

Einstein, Albert, and L. Infeld. The Evolution of Physics, New York: Simon and Schuster, 1938.

Hall, E. Beyond Culture, Garden City, New York: Anchor Press/Doubleday, 1981

Improvement for Undergraduate Education in Texas: College -Level Competencies, Texas Higher Education Coordinating Board, Austin, Texas, 1989.

Knowles, Malcolm S. A History of the Adult Education Movement in the United States, Huntington, New York: R.E. Krieger, 1977.

Toffler, Alvin. The Third Wave, New York: Morrow Press, 1980.

Vaughn, George B. et al (eds.) in Issues for Community College Leaders in a New Era, San Francisco: Jossey-Bass, 1983

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